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EFFECT OF SANITATION-SALVAGE CUTTINGS UPON SUBSEQUENT INSECT-CAUSED PINE MORTALITY

Blacks Mountain Experimental Forest, California

PROGRESS REPORT, 1937-1943

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by

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TABLE OF CONTENTS

INTRODUCTION

HISTORY OF SANITATION-SALVAGE CUTTINGS AT BLACKS MOUNTAIN

BASIS FOR APPRAISING THE RESULTS OF THE CUTTINGS

- Post-cutting mortality
- Predicted natural mortality
- Computation of post-cutting mortality reduction

INSECT CONTROL EFFECTED BY THE CUTTINGS

CONCLUSIONS

SUMMARY

APPENDIX

- Tables A, B, C and D

EFFECT OF SANITATION-SALVAGE CUTTINGS UPON SUBSEQUENT INSECT-CAUSED PINE MORTALITY

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INTRODUCTION

The sanitation-salvage cuttings begun during 1937 in the Blacks Mountain Experimental Forest by the California Forest and Range Experiment Station were among the first large-scale applications of a relatively new method of pine bark beetle control 1/ -- a method which attempts to quell current infestations or prevent their occurrence over short period of time by removing the beetle-susceptible trees from the stands in light utilization cuttings. The cuttings were made annually between 1937 and 1941 to break an aggressive beetle infestation which, between 1933 and 1936, had killed an average of over 200 board feet of ponderosa and Jeffrey pine per acre annually. Results of the cuttings were also expected to permit silvicultural experiments in the forest to proceed uninfluenced by abnormal insect-caused timber drain. Since 1937 the Berkeley Forest Insect Laboratory, in cooperation with the experiment station, has maintained annual records of the insect-caused pine mortality from each of the compartments in the forest. These have proved most valuable as a means of determining the soundness of the principle of controlling insects indirectly be means of this type of cutting.

It is the purpose of this report to show how effective the sanitation-salvage cuttings have been in reducing subsequent mortality from insects for periods of from one to six years. It thereby adds materially to the information presented in the preceding report 2/ on this subject prepared from records covering periods of up to three years following the initial cuttings at Blacks Mountain.

HISTORY OF SANITATION-SALVAGE CUTTINGS AT BLACKS MOUNTAIN

The Blacks Mountain Experimental Forest of nearly 10,000 acres was created by the U. S. Forest Service in 1934 and placed under the administration of the California Forest and Range Experiment Station at Berkeley, California. The area within the forest was originally part of the extensive ponderosa and Jeffrey pine timberlands in the Eastern Lassen Working Circle of the Lassen National Forest and typical of several million acres of timberlands in northeastern California. The experimental forest was created for the purpose of " - - test(ing) the practical value of certain theories of management, silviculture and insect control derived from disconnected studies since 1910." 3/

One of the first activities in the newly created experimental forest was the completion in 1934 by the experiment station of a 100 percent inventory of all trees over 3.6 inches d.b.h. This was followed in 1937 by a survey to determine the timber drain which had occurred between 1933 and 1937 in each of the 100 compartments into which the experimental forest had been subdivided. From this it was found that bark beetles were the principal source of pine mortality. By killing more than 200 board feet of pine per acre during each of these years, they had effected an average yearly net depletion of 76 board feet per acre in the pine stand. It was evident that, before any comprehensive sustained yield studies could be undertaken, insect control measures would be necessary to eliminate the net depletion from this source so as to permit the greatest possible net growth.

Since the bark beetle problem is such an integral part of forest management in northeastern California, the experiment station decided upon a program of insect control as a definite part of its sustained yield program at Blacks Mountain. The method of indirect control by sanitation-salvage cuttings which then had just been developed by this laboratory was selected as most feasible for this purpose. The experiment station and forest insect laboratory together devised a plan which provided for a series of sanitation-salvage cuttings to be applied as rapidly as possible to compartments showing the greatest insect hazard as a preliminary step to the silvicultural and management studies planned for the forest. The laboratory assumed responsibility for such technical details as (1) the marking of the trees to be removed by the cuttings, (2) suggesting the deployment of the cuttings according to the insect hazard of the compartments involved, (3) providing for means to check the insect control effectiveness of the cuttings and (4) acting as consultant on entomological problems which arose during the cutting period.

The first sanitation-salvage cuttings were made by the experiment station in August 1937 and subsequent cuttings were made each season until November 1941. During this time, approximately 7,600,000 board feet of ponderosa and Jeffrey pine were cut from 2,473 acres of the experimental forest (Table 1) and sold to a local lumber company for milling. This volume, representing an average of 2,774 board feet per acre or 15.8 percent of the stand, was made up almost entirely (99 percent) of beetle susceptible trees -- the Risk 3 and 4 trees of the insect risk classification developed by Salman and Bongberg (op. cit.) in 1937. A few low risk trees were cut in some compartments in order to insure an average cut of at least 2,500 board feet per acre.

Terrain and timber conditions, together with the fine net-work of utilization roads constructed throughout the experimental forest between 1934 and 1937, proved to be ideal for the use of sanitation-salvage cuttings. Logging was done by means of tractor-arches and trucks. A portable log loader developed at Blacks Mountain 4/ did much to speed up the frequent movement of the truck landings and to increase the over-all efficiency of this operation.

Table 1. Ponderosa and Jeffrey pine timber removed in sanitation-salvage cuttings between 1937 and 1941. Blacks Mountain Experimental Forest, California.

Year of Cutting	Acreage Cut	Timber Removed in Cuttings		
		Total Volume	Vol./Ac.	% of Stand*
1937	243.0	636,843	2,621	13.3
1938	288.4	866,639	3,005	18.1
1939	577.0	1,665,593	2,887	16.8
1940	651.6	1,851,455	2,841	17.9
1941	982.9	2,587,505	2,633	14.2
TOTALS	2,742.9	7,603,035		
AVERAGES			2,774	15.8

*From the experiment station's 1933-34 inventory.

BASIS FOR APPRAISING THE RESULTS OF THE CUTTINGS

The control effect of a sanitation-salvage cutting is represented by the difference between the subsequent insect-caused pine mortality in the cut-over stand and that in comparable uncut stands. At Blacks Mountain the initial cuttings were made in compartments of high insect hazard and Bongberg, in his 1941 report, was able to make a direct comparison between the post-cutting mortality on these and nearby virgin compartments of the same relative hazard. As the cuttings progressed it became more difficult to make these direct comparisons since most of the cuttings continued to be located in high hazard compartments whereas most of the remaining virgin compartments were of low hazard and therefore not directly comparable. It became necessary in this report to find some other means of checking the results of the cuttings.

To do this, a comparison was first made between the pre-cutting mortality in the 35 compartments selected for cutting and the corresponding cruised mortality in the virgin compartments. This showed (Table 2) that the natural mortality rate in virgin stands was greater in the compartments selected for cutting than for the forest as a whole, but that the infestation trend was the same in both cases. From this it was assumed that (1) the pre-cutting mortality rate of the cut compartments could be projected over the post-cutting years in accordance with the natural mortality trend (Figure 1) on the virgin compartments of the forest, (2) the "predicted mortality" thus obtained (Table 2) would be a valid expression of the mortality which would have occurred on the cut compartments had no cuttings been made, and (3) the difference between this "predicted mortality" and the mortality actually cruised on the cut compartments following the cuttings could be considered as a measure of the reduction in mortality, and hence the amount of insect control, effected by the cuttings.

Table 2. Summary of Table D, Appendix. (Comparison between insect-caused pine mortality cruised on all virgin compartments, cruised on cut compartments before cutting and predicted on cut compartments if no cuttings had been made. Blacks Mountain Experimental Forest.)

Year	Cruised mortality on virgin compartments			Pre-cutting mortality cruised on cut comp'ts.			Predicted mortality on cut compartments		
	Acreage	b.m./Ac.	% Stand	Acreage	b.m./Ac.	% Stand	Acreage	b.m./Ac.	% Stand
1933-36	9,134.7	168.0	.98	2,742.9	211.2	1.20	322.0	243.0	1.30
1937	9,134.7	65.0	.38	2,742.9	85.6	.49	322.0	94.9	.51
1938	8,688.2	61.5	.36	2,420.9	87.2	.50	322.0	86.3	.46
1939	8,026.9	99.4	.58	1,945.3	128.1	.74	797.6	128.4	.71
1940	6,839.7	117.5	.70	1,112.3	135.3	.75	1,630.3	123.7	.72
1941	6,228.0	44.5	.27	672.3	40.3	.23	2,070.6	50.9	.29
1942	5,365.5	35.5	.33	All compartments cut			2,742.9	38.1	.22
1943	4,393.1	18.0	.11	All compartments cut			2,329.9	22.5	.13

The latter assumption above is actually the basis for the method used here to determine the effectiveness of the Blacks Mountain cuttings. The determination of the mortality reduction involves three preliminary steps: (1) the tabulation of the yearly post-cutting mortality on the cut compartments, (2) the computing of the "predicted" natural mortality for the same years assuming the compartments had not been cut, and (3) the final calculation of the average yearly reduction in post-cutting mortality on the cut compartments.

Post-cutting Mortality.

The number and volume of ponderosa and Jeffrey pine trees (12 inches d.b.h. and over) killed by bark beetles on the compartments each year after cutting are recorded in Table B, Appendix. These data were obtained from the mortality summaries of the annual beetle surveys conducted in the experimental forest. The 1943 mortality record was omitted on five of the compartments (G 6-10, G 12-10, G 12-14, G 15-13 and G 15-15), since it was rendered incomparable by reason of the silvicultural cuttings which were applied to these compartments that year.

Some explanation should be made of the apparent discrepancy in the grouping of compartments with respect to cutting dates in Tables A and B, Appendix. Table A, Appendix, is merely a listing of compartments according to the calendar years in which each was cut. The basis for testing the effectiveness of the Blacks Mountain cuttings is the yearly record of insect-caused pine losses which occurred on each compartment after cutting. If the occurrence of these losses in any one calendar year was evenly distributed throughout that year, then the grouping of the compartments by year of cutting in Table B, Appendix, would be the same as in Table A, Appendix. But this is not the case, for the mortality occurring in any one calendar year at Blacks Mountain is usually confined to the period between July 1 and October 1. As an example, the 1938 mortality, though labelled "1938,"

occurred mostly during these three months. The compartments cut from July to October of any year were therefore grouped with the compartments cut between October 1 of that year and June 1 of the following year. Likewise, compartments cut between January 1 and June 30 of any one year were grouped with compartments cut between July 1 and December 30 of the preceding year.

Compartment G 0-14, for instance, was cut in June 1938 before the attacks and development of the 1938 broods of bark beetles. The mortality record for the first year after cutting, therefore, would be that for 1938, the same as for compartments G 2-14, G 6-10 and G 8-10 cut in August and September of 1937.

Predicted natural mortality.

The predicted natural mortality in number of trees and volume, shown in Tables C and D, Appendix, and in Table 2, represents the average mortality which presumably would have occurred on the cut compartments if no sanitation-salvage cuttings had been made. These averages were derived by projecting the average annual pre-cutting (1933-36 period) mortality rate over the post-cutting periods according to the natural trend (Figure 1) on the virgin compartments.

Computation of post-cutting mortality reduction.

The reduction in insect-caused mortality after cutting is measured as the difference between the predicted natural mortality (Table C, Appendix) on the cut compartments and the mortality which actually occurred ("Totals," Table B, Appendix). This gave the yearly post-cutting mortality reduction for each compartment cut.

The final step in the determination of the effectiveness of the cuttings is the computation of the average reduction in mortality for periods of one to six years following the cuttings. The procedure used to obtain these averages can be explained a little more clearly by the use of Figure 2 which is nothing more than a diagrammatic representation of Table B, Appendix, to show the compartment arrangement by year of cutting and period of subsequent loss record. The computations made in the preceding paragraph resulted in a mortality reduction value for each of the colored rectangular spaces in the diagram. The mortality reduction one year after the cuttings was the average of the reductions obtained for each of the compartments and for the years indicated by the yellow rectangles in Figure 2. Compartments having yellow-green combinations were used for the two-year period tests, those with yellow-green-orange combinations for the three-year period tests, and so on.

As may be seen, the number of compartments available for these tests diminished after the two-year period test as shown on the next page:

Period of Test	Compartments available for tests	
	Number	Acreage
1 year	35	2,742.9
2 year	35	2,742.9
3 year	26	2,070.6
4 year	19	1,578.3
5 year	6	531.4
6 year	3	227.2

INSECT CONTROL EFFECTED BY THE CUTTINGS

The "bug-proofing" effect of the cuttings at Blacks Mountain as first indicated by Bongberg in 1941 appears to be upheld and amplified by the results obtained from the current study. These show that insect-caused pine mortality on the cutover compartments averaged only 5.1 percent of the predicted natural mortality one year after the cuttings were made. From this, it might be inferred that the cuttings brought about a reduction in pine losses of 94.9 percent in the first year which followed. The cumulative mortality reductions secured for periods of one to six years following the cuttings are shown in Table 3.

Table 3. Reductions in insect-caused pine mortality for period of one to six years following sanitation-salvage cuttings. Blacks Mountain Experimental Forest, California.

Period following cutting	Basis of sample (acres)	Natural * Mortality		Mortality after cutting		Average reduction in mortality		
		Trees	Volume	Trees	Volume	Trees	Volume	Percent**
1 year	2,742.9	201	224,067	21	11,386	180	212,681	94.9
2 year	2,742.9	371	402,509	54	45,083	317	357,426	88.8
3 year	2,070.6	451	475,111	65	55,953	386	419,158	88.2
4 year	1,578.3	443	455,246	66	56,646	377	398,600	87.6
5 year	531.4	279	260,935	54	40,274	225	220,661	84.6
6 year	227.2	136	116,507	25	19,630	111	96,877	83.2

* Predicted mortality on cutover compartments if no cuttings had been made.
**Cumulative, based upon volume reduction.

This tabulation shows that, while the initial measure of control diminished during the six years of the study, the rate of losses on the cutover compartments at the end of the six-year period was still 83.2 percent under the natural mortality rate. In other words, though the effectiveness of the cuttings declined they did so at a rate of only 2 percent per year.

CONCLUSIONS

It is evident that very satisfactory insect control has been achieved and maintained for periods of up to six years by the sanitation-salvage cuttings made at Blacks Mountain between 1937 and 1941. The fact that this was accomplished during a period when the natural mortality rate was declining to normalcy does not in any way diminish the significance of this type of cutting as an insect control device. The Blacks Mountain cuttings, though, along with other similar cuttings in northeastern California and eastern Oregon and Washington, still do not answer one question uppermost in the minds of many timber owners regarding the effectiveness of the cuttings in preventing heavy losses during periods when natural conditions favor the build-up or prolongation of epidemic infestations. This consideration should not stand in the way of widespread acceptance of this method of controlling insects in pine stands similar to that at Blacks Mountain, however, since it is believed that the results offered above definitely establishes the use of these cuttings for this purpose.

One of the most gratifying features of the results at Blacks Mountain is the manner in which the insect control achieved by the cuttings has been sustained. One explanation for this might be the fact that studies of the insect risk of individual trees indicated that the removal of the high risk trees from a stand would give approximately ten years of protection from beetles to the residual stand. However, most of these studies were conducted in the general vicinity of Blacks Mountain between 1936 and 1938 when the bark beetle infestations were far heavier than they were during or following the sanitation-salvage cuttings on the experimental forest. It is believed that this natural decline in the infestation brought about an increase in the resistance to beetle attack displayed by the low risk trees left after the cuttings. This, in turn, presumably is responsible for the longer period of protection which appears to be developing from the cuttings.

Other reasons for the longer protection period achieved may be an improvement in the risk classification and its application. The classification was changed from a three- to a four-class system in 1938 in order to gain a more refined delineation between low and high risk trees. Since the same personnel marked most of the trees for cutting between 1937 and 1941, it may be assumed that certain improvements in the judgment of the men themselves may have been made in marking for the later cuttings. This may be illustrated by a comparison of several factors for comparable periods of time in the 1941 Blacks Mountain report by Bongberg and in this report:

	1941 Data	1946 Data
Reduction in mortality one year after cutting	90.6%	94.9%
Reduction in mortality three yrs. after cutting	71.9%	88.2%
Difference in three years	18.7%	6.7%

The results in 1941, limited to data from compartments cut between 1937 and 1939, showed (1) less reduction to begin with, hence less insect control and (2) more rapid diminishing of control effects. These same data in 1946,

augmented by data from compartments cut in 1940 and 1941, showed greater and more lasting control effect. This indicated a greater efficiency in the later cuttings which could be attributed to the improvements in the risk classification and its application as suggested above or to the change in natural infestation trend (Figure 1) from an increase before to a decrease after 1940.

Further study is planned for the 1937-41 sanitation-salvage cuttings at Blacks Mountain. Through the cooperation of the experiment station and the forest insect laboratory compartments cut during this period will be studied until ten years of records have been amassed. By that time it is hoped that there will be additional and conclusive proof of the magnitude and duration of the insect control which may be expected from these cuttings.

SUMMARY

The first attempt to control bark beetle outbreaks by means of sanitation-salvage cuttings was made between 1937 and 1941 at the Blacks Mountain Experimental Forest in northeastern California by the California Forest and Range Experiment Station in cooperation with the Berkeley forest insect laboratory. The cuttings were planned for the purpose of breaking up heavy bark beetle infestations which then were causing an average pine mortality equivalent to an estimated 76 board feet per acre net depletion in pine resources.

The cuttings removed and utilized an average of 2,774 board feet of ponderosa and Jeffrey pine, or approximately 15.8 percent of the combined pine stand. Ninety-nine percent of the volume cut was composed of high risk trees, trees currently susceptible to bark beetle attack. Acreage included in the cuttings totalled 2,743 at the close of the 1941 season.

Annual surveys of the virgin and cutover compartments carried on annually in the experimental forest by the laboratory since 1937 provide the basis for determining the reduction in beetle-caused pine mortality obtained after the cuttings. The actual reductions secured for periods of from one to six years following the cuttings were computed by comparing the average mortality for comparable periods of time on the cutover compartments with the predicted natural mortality which presumably would have occurred if the compartments had not been cut. The predictions were based on the trends of the annual beetle infestations on the uncut portions of the forest.

Results showed that, for the periods indicated, pine mortality due to bark beetles was reduced following cuttings as follows:

Period after Cutting	Cumulative reduction in Mortality
1 year	94.9%
2 year	88.8%
3 year	88.2%
4 year	87.6%
5 year	84.6%
6 year	83.2%

The tests at Blacks Mountain indicate that the sanitation-salvage cuttings there were very effective not only in reducing subsequent pine losses but in maintaining the reduction over a longer period of time than was originally anticipated. It is believed that this was due, in part, to improvements made to the high risk marking rules in 1938, to the greater familiarity with and hence more effective application of the rules by marking personnel as the cuttings progressed, and to the general decline in bark beetle infestations experienced in and adjacent to the experimental forest during the period following most of the cuttings.

Further studies of the 1937-41 cuttings at Blacks Mountain will be made so that their effect on subsequent beetle-caused pine mortality can be determined for period of up to ten years.

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Logging high risk trees to control insects in the pine stands of northeastern California. Jour. For. 40(7):533-539. July 1942

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(3) California Forest and Range Experiment Station
Guide to the Blacks Mountain Experimental Forest, a sustained yield experiment in ponderosa pine in northeastern California. Berkeley, California. 1938. (Multilithed)

(4) Hasel, A. A. The Blacks Mountain portable log loader. Forest Research Note 43. California Forest and Range Experiment Station, Berkeley, California. January 1945 (Multilithed)

(APPENDIX) Table A. Record of sanitation-salvage cuttings from 1937 to 1941*. Blacks Mtn. Exp. Forest, California.

Calendar year of cutting	Compartment	Timbered acreage	Original pine stand b.m./ac.	Amount of stand removed in cutting	
				b.m./ac.	Percent
1937	G 2-14	81.3	17,484	2,741	15.7
	G 6-10	94.8	21,872	2,473	11.3
	G 8-10	66.9	19,213	2,684	14.0
		Average	19,672	2,621	13.3
1938	B 25-1	113.7	16,312	2,569	15.7
	B 27-4	95.7	17,463	3,892	22.3
	G 0-14	79.0	16,104	2,558	15.9
		Average	16,637	3,005	18.1
1939	G 4-15	105.0	21,284	2,694	12.7
	G 12-10	111.6	17,342	2,550	14.7
	G 12-14	91.1	17,832	2,760	15.5
	G 15-10	131.9	12,353	2,668	21.6
	G 15-13	52.0	16,937	3,858	22.8
	G 15-15	63.5	19,720	3,564	18.1
	G 17-3	21.9**	17,300	3,099	11.3
		Average	17,220	2,887	16.8
1940	G 9-10	66.2	20,676	3,159	15.6
	G 11-4	115.2	12,433	2,144	17.2
	G 11-8	88.8	20,307	2,668	13.1
	G 14-3	53.4**	20,792	3,265	13.9
	G 14-6	86.7	14,003	3,288	23.5
	G 17-6	48.1**	15,218	4,692	29.8
	G 18-9	63.5	10,852	1,210	11.2
	P 18-30	88.6	17,286	2,978	17.2
	P 18-33	41.1	10,666	3,227	30.3
		Average	15,837	2,841	17.9
1941	C 8-30	94.5	15,755	2,864	18.2
	C 11-33	53.4	16,026	2,828	17.6
	C 13-31	85.9**	16,947	2,975	17.6
	C 14-28	123.9	16,828	3,275	19.5
	C 15-23	100.3	19,609	2,165	11.0
	C 15-25	71.4	18,224	2,339	12.8
	P 15-33	139.1	18,686	2,527	13.5
	P 18-27	84.3	18,437	2,452	13.3
	P 19-25	36.4**	22,561	2,541	11.3
	P 20-32	43.9**	23,933	1,929	8.1
	P 22-24	47.1**	22,305	2,687	12.0
	P 23-31	50.8	19,059	1,314	6.9
	P 24-21	51.9**	20,553	3,693	18.0
		Average	18,582	2,633	14.2
Average of all cuttings			17,535	2,774	15.8

* From records of the California Forest and Range Experiment Station.
**Area outside of study plots

(APPENDIX) Table B. Number and volume of ponderosa and Jeffrey pine trees killed yearly by bark beetles following sanitation-salvage cuttings, by compartments. Blacks Mountain Experimental Forest, California.

Compartment	Timbered acreage	1938		1939		1940		1941		1942		1943	
		Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume
CUT IN 1937 (July 1, 1937, to June 30, 1938)													
G 0-14	79.0	1	312	3	4654	0	0	5	4885	0	0	0	0
G 2-14	81.3	5	1861	2	1099	3	1008	1	428	0	0	0	0
G 6-10	94.8	1	1266	5	6533	3	2605	1	312	2	1916	-	-
G 8-10	66.9	2	1630	2	1578	1	2058	0	0	1	117	0	0
Totals	322.0	9	5069	12	13,864	7	5671	7	5625	3	2033	0	0
Average per acre			15.7	.037	43.1	.022	17.6	.022	17.5	.009	6.3	0	0
Timbered acreage by years			322.0		322.0		322.0		322.0		322.0		227.2
CUT IN 1938 (July 1, 1938, to June 30, 1939)													
B 25-1	113.7			2	1353	3	1706	0	0	1	416	0	0
B 27-4	95.7			2	1007	4	1835	3	1267	1	428	0	0
G 12-10	111.6			1	588	1	4242	0	0	0	0	-	-
G 12-14	91.1			0	0	1	810	0	0	1	609	-	-
G 15-15	63.5			1	1218	0	0	1	1720	0	0	-	-
Totals	475.6			6	4166	9	8593	4	2987	3	1453	0	0
Average per acre				.013	8.8	.019	18.1	.008	6.3	.006	3.1	0	0
Timbered acreage by years					475.6		475.6		475.6		475.6		209.4
CUT IN 1939 (July 1, 1939, to June 30, 1940)													
G 4-15	105.0					1	440	1	117	0	0	2	2538
G 9-10	66.2					0	0	1	2710	0	0	0	0
G 11-4	115.2					0	0	0	0	0	0	1	428
G 11-8	88.8					0	0	0	0	0	0	0	0
G 14-3	53.4					0	0	0	0	0	0	0	0
G 14-6	86.7					0	0	1	1416	0	0	0	0
G 15-10	131.9					0	0	1	981	0	0	0	0
G 15-13	52.0					1	118	0	0	0	0	-	-
G 17-3	21.9					0	0	0	0	1	588	0	0
G 17-6	48.1					0	0	0	0	0	0	0	0
G 18-9	63.5					0	0	0	0	0	0	0	0
Totals	832.7					2	558	4	5224	1	588	3	2966
Average per acre						.002	0.7	.005	6.3	.001	0.7	.004	3.8
Timbered acreage by years							832.7		832.7		832.7		780.7

CUT IN 1940 (July 1, 1940, to June 30, 1941)							
P 15-33	139.1	0	0	0	0	0	0
P 18-27	84.3	1	440	3	1377	0	0
P 18-30	88.6	1	773	3	2471	0	0
P 18-33	41.1	0	0	0	0	1	2002
P 19-25	36.4	0	0	1	118	0	0
P 23-31	50.8	0	0	2	2052	0	0
Totals	440.3	2	1213	8	6018	1	2002
Average per acre		.004	2.5	.016	12.4	.002	4.1
Timbered acreage by years			440.3		440.3		440.3
CUT IN 1941 (July 1, 1941, to June 30, 1942)							
C 8-30	94.5			0	0	0	0
C 11-33	53.4			0	0	0	0
C 13-31	85.9			0	0	0	0
C 14-28	123.9			0	0	0	0
C 15-23	100.3			0	0	0	0
C 15-25	71.4			0	0	0	0
P 20-32	43.9			2	380	0	0
P 22-24	47.1			0	0	0	0
P 24-21	51.9			0	0	0	0
Totals	672.3			2	380	0	0
Average per acre				.003	0.6	0	0
Timbered acreage by years					672.3		672.3

(APPENDIX) Table C. Predicted natural insect-caused pine mortality on compartments cut by sanitation-salvage if no cuttings had been made. Blacks Mtn. Exp. Forest.

Year cut	Compartmens used *	Total acreage	Average annual mortality 1933-36 (board feet)	Predicted natural mortality (Board-foot volume) 1938	1939	1940	1941	1942	1943
1937	a.	322.0	78,316	27,794	44,593	50,396	19,548	14,661	
	b.	227.2	55,119						6,019
1938	c.	475.6	101,579		57,839	65,366	25,354	19,016	
	d.	209.4	59,095						6,453
1939	e.	832.7	133,575			85,955	33,340	25,005	
	f.	780.7	122,189						13,343
1940	g.	440.3	108,919				27,186	20,389	11,894
1941	h.	672.3	135,114					25,293	14,754

* Basis:
a. Compartments; G 0-14, G 2-14, G 6-10, G 8-10
b. Compartments; G 0-14, G 2-14, G 8-10
c. Compartments; B 25-1, B 27-4, G 12-10, G 12-14, G 15-15
d. Compartments; B 25-1, B 27-4
e. Compartments; G 4-15, G 9-10, G 11-4, G 11-8, G 14-3, G 14-6, G 15-10, G 15-13, G 17-3, G 17-6, G 18-9
f. Compartments; same as "e" less G 15-13
g. Compartments; P 15-33, P 18-27, P 18-30, P 19-25, P 18-33, P 23-31
h. Compartments; C 8-30, C 11-33, C 13-31, C 14-28, C 15-23, C 15-25, P 20-32, P 22-24, P 24-21

(APPENDIX) Table D. Comparison between insect-caused pine mortality cruised on all virgin compartments, cruised on cut compartments before cutting and predicted on cut compartments if no cuttings had been made. Blacks Mtn. Exp. Forest.

Year	Acreage	No. of trees	Volume (b.m.)	Volume per ac.	% of stand
Part 1. Cruised mortality on virgin compartments.					
1933-36	9,134.7	1,305	1,534,954	168.0	.98
1937	9,134.7	448	593,956	65.0	.38
1938	8,688.2	382	534,430	61.5	.36
1939	8,026.9	569	797,920	99.4	.58
1940	6,839.7	628	803,878	117.5	.70
1941	6,228.0	208	277,351	44.5	.27
1942	5,365.5	130	190,582	35.5	.33
1943	4,393.1	56	78,903	18.0	.11
Part 2. Cruised mortality on cut compartments before cutting.					
1933-36	2,742.9	496	579,374	211.2	1.20
1937	2,742.9	187	234,744	85.6	.49
1938	2,420.9	136	211,123	87.2	.50
1939	1,945.3	179	249,228	128.1	.74
1940	1,112.3	120	150,573	135.3	.75
1941	672.3	23	27,095	40.3	.23
Part 3. Predicted mortality on cut compartments.					
1933-36	322.0	88	78,316	243.0	1.30
1937	322.0	34	30,543	94.9	.51
1938	322.0	31	27,794	86.3	.46
1939	797.6	107	102,432	128.4	.71
1940	1,630.3	189	201,717	123.7	.72
1941	2,070.6	98	105,428	50.9	.29
1942	2,742.9	93	104,364	38.1	.22
1943	2,329.9	48	52,463	22.5	.13